REMARKS

By the present amendment and response, independent claim 1 and dependent claim 2 have been amended to overcome the Examiner's objections. Claims 1-10, 21-22, and 25-30 are pending in the present application. Reconsideration and allowance of pending claims 1-10, 21-22, and 25-30 in view of the following remarks are requested.

The Examiner has rejected claims 1-10, 21, 22, and 25-30 under 35 USC §112, second paragraph. Applicant has amended independent claim 1 and submits that the requirements of 35 USC §112, second paragraph, have been met.

The Examiner has further rejected claims 1-10, 21, 22, and 25-30 under 35 USC §103(a) as being unpatentable over U.S. patent application publication number 2002/0127847 to Alling et al. ("Alling") in combination with U.S. patent number 6,398,926 B1 to Lotar Peter Mahneke ("Mahneke"), U.S. patent number 3,706,635 to Xavier Kowalski ("Kowalski"), and U.S. patent number 6,486,533 B2 to Krishnamoorthy et al. ("Krishnamoorthy"). For the reasons discussed below, Applicant respectfully submits that the present invention, as defined by amended independent claim 1, is patentably distinguishable over Alling, Mahneke, Kowalski, and Krishnamoorthy, singly or in any combination thereof.

The present invention, as defined by amended independent claim 1, includes, among other things, electroplating a copper (Cu) surface in a chemical solution, where the chemical solution comprises at least one wetting agent for stabilizing the chemical solution, "wherein the at least one wetting agent is dissolved in a volume of deionized

(DI) water," and "wherein the chemical solution does not etch the Cu surface." As disclosed in the present application, the present invention provides a Cu-Zn electroplating solution that facilitates improved filling of a Cu-Zn alloy film on an interconnect, especially for feature sizes in a dimensional range of approximately 0.2 μm to approximately 0.05 μm, thereby lowering the resistance of the formed Cu-Zn alloy film. As disclosed in the present application, the present invention's Cu-Zn electroplating solution has a beneficial characteristic of not etching copper or a copper alloy seed layer, which advantageously enhances the filling capability of the Cu-Zn electroplating solution.

Furthermore, the Cu-Zn alloy film is electroplated on a Cu surface using a stable chemical solution in prescribed concentration ranges. For example, the chemical solution can comprise at least one wetting agent, where the at least one wetting agent is provided in a concentration less than 0.1 g/L, and where the at least one wetting agent is dissolved in a volume of deionized (DI) water. As a result, the present invention advantageously achieves improved Cu interconnect reliability, improved corrosion resistance, and reduced manufacturing costs.

In contrast to the present invention as defined by amended independent claim 1, Alling does not teach, disclose, or suggest electroplating a copper (Cu) surface in a chemical solution, where the chemical solution comprises at least one wetting agent for stabilizing the chemical solution, "wherein the at least one wetting agent is dissolved in a volume of deionized (DI) water," and "wherein the chemical solution does not etch the Cu surface." Alling specifically discloses plating baths that preferably employ an acidic

electrolyte, which typically will be an acidic aqueous solution and that preferably contains a halide ion source, particularly a chloride ion source. See, for example, Alling, page 3, paragraph [0030]. However, Alling fails to teach, disclose, or suggest electroplating a Cu surface in a chemical solution, thereby forming a Cu-Zn alloy film on the Cu surface, where the chemical solution does not etch the Cu surface, as specified in amended independent claim 1.

Furthermore, Alling fails to teach, disclose, or suggest a chemical solution comprising at least one wetting agent for stabilizing the chemical solution, where the at least one wetting agent is dissolved in a volume of deionized (DI) water. In fact, Alling does not even mention deionized (DI) water.

In contrast to the present invention as defined by amended independent claim 1, Mahneke does not teach, disclose, or suggest electroplating a copper (Cu) surface in a chemical solution, where the chemical solution comprises at least one wetting agent for stabilizing the chemical solution, "wherein the at least one wetting agent is dissolved in a volume of deionized (DI) water," and "wherein the chemical solution does not etch the Cu surface." The Examiner relies on Mahneke for providing motivation to enable the formation of the copper-zinc alloy film of Alling to be performed and obtain further advantage of preventing contamination on both surfaces of the wafer. Mahneke specifically discloses an electroplating chamber having a rotatable chuck, i.e. chuck 44, which allows plating, rinsing, and drying steps of an electroplating process to be performed in the same chamber. See, for example, Mahneke, column 2, lines 28-38 and

column 5, lines 6-7. However, Mahneke fails to teach, disclose, or suggest, chemical solution for electroplating a Cu-Zn alloy film on a Cu surface, where the chemical solution comprises at least one wetting agent for stabilizing the chemical solution, and where the at least one wetting agent is dissolved in a volume of deionized (DI) water. Further, Mahneke fails to teach, disclose, or suggest electroplating a Cu surface in a chemical solution, thereby forming a Cu-Zn alloy film on the Cu surface, where the chemical solution does not etch the Cu surface, as specified in amended independent claim 1. Thus, Mahneke fails to cure the basic deficiencies of Alling discussed above.

In contrast to the present invention as defined by amended independent claim 1, Kowalski does not teach, disclose, or suggest electroplating a copper (Cu) surface in a chemical solution, where the chemical solution comprises at least one wetting agent for stabilizing the chemical solution, "wherein the at least one wetting agent is dissolved in a volume of deionized (DI) water," and "wherein the chemical solution does not etch the Cu surface." The Examiner relies on Kowalski to provide the motivation to enable the step of admixing the chemical solution with a volume of water in the combination process to be performed. Kowalski specifically discloses plating solutions prepared in deionized water by first adding potassium hydroxide followed by a particular ligand and then a copper salt, which was copper sulfate. See, for example, Kowalski, column 10, lines 16-20.

However, the plating solution disclosed in Kowalski, which comprises deionized water, does not contain a zinc ion source and, as such, the plating solution cannot be

utilized to form a Cu-Zn alloy film on a Cu surface. Furthermore, Kowalski fails to teach, disclose, or suggest a chemical solution, where the chemical solution comprises at least one wetting agent for stabilizing the chemical solution, and where the at least one wetting agent is dissolved in a volume of deionized (DI) water. Furthermore, Kowalski fails to teach, disclose, or suggest electroplating a Cu surface in a chemical solution, thereby forming a Cu-Zn alloy film on the Cu surface, where the chemical solution does not etch the Cu surface, as specified in amended independent claim 1. Thus, the combination of Kowalski and Mahneke fails to cure the basic deficiencies of Alling discussed above.

In contrast to the present invention as defined by amended independent claim 1, Krishnamoorthy does not teach, disclose, or suggest electroplating a copper (Cu) surface in a chemical solution, where the chemical solution comprises at least one wetting agent for stabilizing the chemical solution, "wherein the at least one wetting agent is dissolved in a volume of deionized (DI) water," and "wherein the chemical solution does not etch the Cu surface." The Examiner relies on Krishnamoorthy to provide the motivation to enable the formation of the chemical solution of the combination process to be performed and obtain further advantage of solving the diffusion and self-passivation problems in metallization structure.

However, Krishnamoorthy fails to teach, disclose, or suggest a chemical solution, where the chemical solution comprises at least one wetting agent for stabilizing the chemical solution, and where the at least one wetting agent is dissolved in a volume of

deionized (DI) water. Furthermore, Krishnamoorthy fails to teach, disclose, or suggest electroplating a Cu surface in a chemical solution, thereby forming a Cu-Zn alloy film on the Cu surface, where the chemical solution does not etch the Cu surface, as specified in amended independent claim 1. Thus, the combination of Kowalski, Mahneke, and Krishnamoorthy fails to cure the basic deficiencies of Alling discussed above.

For the foregoing reasons, Applicant respectfully submits that the present invention, as defined by amended independent claim 1, is not suggested, disclosed, or taught by Alling, Mahneke, Kowalski, and Krishnamoorthy, either singly or in combination thereof. As such, the present invention, as defined by amended independent claim 1, is patentably distinguishable over Alling, Mahneke, Kowalski, and Krishnamoorthy. Thus claims 2-10, 21, 22, and 25-30 depending from amended independent claim 1 are, *a fortiori*, also patentably distinguishable over Alling, Mahneke, Kowalski, and Krishnamoorthy for at least the reasons presented above and also for additional limitations contained in each dependent claim.

Based on the foregoing reasons, the present invention, as defined by amended independent claim 1 and claims depending therefrom, is patentably distinguishable over the art cited by the Examiner. Thus, claims 1-10, 21-22, and 25-30 pending in the present application are patentably distinguishable over the art cited by the Examiner. As such, and for all the foregoing reasons, an early allowance of claims 1-10, 21-22, and 25-30 pending in the present application is respectfully requested.

Attorney Docket No.: 0180199

Respectfully Submitted,
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Date: 7/14/04

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